

CLAIMS

1. A light scattering type smoke sensor comprising:
a sensor body;
a light-emitter that is incorporated in the sensor body to emit light toward an
5 open smoke-sensing space located outside the sensor body;
a light-receiver that is incorporated in the sensor body to receive scattered
light generated by the light emitted from the light-emitter to the smoke-sensing
space, and to output a light-received signal corresponding to an amount of
received light scattered; and
10 a fire judging unit that judges presence/absence of fire occurrence based
on the amount of received light identified by the light-received signal output from
the light-receiver.
2. The light scattering type smoke sensor according to claim 1, wherein the
15 fire judging unit judges the present/absence of the fire occurrence based on the
amount of received light and a differential value of the amount of received light.
3. The light scattering type smoke sensor according to claim 2, wherein the
fire judging unit judges that fire occurs when the amount of received light exceeds
20 a predetermined fire threshold and the differential value of the amount of received
light is equal to or lower than a predetermined false alarm threshold.
4. The light scattering type smoke sensor according to claim 3, wherein
when the amount of received light exceeds the predetermined fire threshold,
25 and the differential value of the amount of received light exceeds the
predetermined false alarm threshold, the fire judging unit checks whether the
amount of received light exceeds a predetermined obstacle threshold or not when
a predetermined time elapses since the time the differential value exceeds the
predetermined false alarm threshold, and judges that there is an obstacle for fire
30 sensing when the amount of received light exceeds the obstacle threshold.
5. The light scattering type smoke sensor according to claim 1, wherein
the fire judging unit judges that fire occurs, when the amount of received
light exceeds a predetermined first fire threshold for a time equal to or longer than
35 a predetermined first set time, and the amount of received light exceeds a

predetermined second fire threshold which is higher than the first fire threshold for a time equal to or longer than a predetermined second set time which is longer than the first set time.

- 5 6. The light scattering type smoke sensor according to any one of claims 1 to 5, wherein
the light-emitter has plural light-emitters.
7. The light scattering type smoke sensor according to claim 6, wherein
10 the light-emitter has first light-emitter that emits light of a first wavelength, and second light-emitter that emits light of a second wavelength which is shorter than the first wavelength, and
a first scattering angle formed by mutual crossing of a light axis of the first light-emitter and a light axis of the light-receiving element is smaller than a second
15 scattering angle formed by mutual crossing of a light axis of the second light-emitter and the light axis of the light-receiving element.
8. The light scattering type smoke sensor according to claim 7, wherein
a central wavelength of the first wavelength is equal to or longer than 800
20 nm,
a central wavelength of the second wavelength is equal to or shorter than 500 nm,
the first scattering angle falls within a range of 20° to 50°, and
the second scattering angle falls within a range of 100° to 150°.
- 25 9. The light scattering type smoke sensor according to claim 6, wherein
the light-emitter has first light-emitter and second light-emitter,
the first light-emitter emits light having a polarization plane vertical to a first scattering plane that passes through a light axis of the first light-emitter and a light
30 axis of the light-receiving element,
the second light-emitter emits light having a polarization plane parallel to a second scattering plane that passes through a light axis of the second light-emitter and the light axis of the light-receiving element, and
a first scattering angle formed by mutual crossing of the light axis of the first
35 light-emitter and the light axis of the light-receiving element is smaller than a

second scattering angle formed by mutual crossing of the light axis of the second light-emitter and the light axis of the light-receiving element

10. The light scattering type smoke sensor according to claim 9, wherein
5 the first scattering angle is equal to or smaller than 80° , and
the second scattering angle is equal to or larger than 100° .
11. The light scattering type smoke sensor according to any one of claims 6 to
10, wherein
10 the plural light-emitters are arranged at solid angles, so that planes
including respective light axes of the plural light-emitters and the light axis of the
light-receiving element are substantially not identical with each other.
12. The light scattering type smoke sensor according to any one of claims 6 to
15 11, wherein
the light-emitter includes first light-emitter and second light-emitter,
the fire judging unit compares an amount of received light by the light-
receiver with respect to scattered light generated from the light emitted by the first
light-emitter and scattered by smoke, and an amount of received light by the light-
20 receiver with respect to scattered light generated from the light emitted by the
second light-emitter and scattered by the smoke, to identify a type of the smoke,
and judges the presence/absence of fire occurrence based on a standard
corresponding to the type of the smoke.
13. The light scattering type smoke sensor according to any one of claims 1 to
25 12, wherein
a mutual crossing point of the light axis of the light-emitter and the light axis
of the light-receiver in the smoke-sensing space is at least approximately 5 mm
away from the sensor body.
14. The light scattering type smoke sensor according to any one of claims 1 to
30 13, wherein at least one portion of an outer surface of the sensor body is
configured by an insect avoiding material, or an insect avoiding agent is applied or
made to permeate to at least one portion of the outer surface of the sensor body.

15. The light scattering type smoke sensor according to any one of claims 1 to 14, wherein
the light-receiver has an angle of field of view not larger than 5 degrees.
- 5 16. The light scattering type smoke sensor according to any one of claims 1 to 15, wherein
the light-emitter emits collimated parallel beam.
- 10 17. The light scattering type smoke sensor according to any one of claims 1 to 16, further comprising
a logarithmic amplifier which amplifies the light-received signal output from the light-receiver.
- 15 18. The light scattering type smoke sensor according to any one of claims 1 to 17, further comprising
a light emission controller that drives the light-emitter to intermittently emit light by using a modulated light-emission signal, and
an amplifier that amplifies the light-received signal output from the light-receiver in synchronization with the modulated light-emission signal.
- 20 19. The light scattering type smoke sensor according to claim 18, further comprising
a light emission controller that drives the light-emitter to intermittently emit light by using a modulated light-emission signal, wherein
25 the light-emitter emits light within a visible light wavelength band, and
the light emission controller drives to intermittently emit light at a light-emission pulse width of equal to or smaller than 1 millisecond.
- 30 20. The light scattering type smoke sensor according to claim 19, wherein
the light emission controller sets a total light emission time period in an intermittent light emission equal to or smaller than 1 millisecond.